FLH-11102/29
42203sh

POSTERIOR SPINAL RECONSTRUCTION SYSTEM

REFERENCE TO RELATED APPLICATION

This application claims priority from U.S. Provisional Patent Application Serial Nos. 60/456,177, filed March 20, 2003 and 60/475,161, filed June 2, 2003, the entire content of both of which is incorporated herein by reference.

FIELD OF THE INVENTION

This invention relates generally to spinal reconstruction and, more particularly, to a system that may be fixed in place to stabilize a spinal fusion, or released for dynamic motion.

BACKGROUND OF THE INVENTION

Current posterior spinal reconstruction apparatus involves the use of pedicle screw and rod fixation and facet fixation. The pedicle screw/rod fixation systems are typically used in conjunction with a posterior-lateral and/or intervertebral fusion mechanism. Spinal fixation systems also typically involve some form of fusion. One of the problems with existing approaches is that, due to the fusion involved, the vertebrae are truly mechanically linked to one another, thereby limiting mobility.

SUMMARY OF THE INVENTION

This invention improves upon existing techniques by providing a system that may be fixed in place to stabilize a spinal fusion, or released for dynamic motion, thereby providing stability with flexibility in conjunction with artificial mechanical or plasma discs, or normal physiologic discs.

In terms of apparatus, the invention involves pedicle fixation utilizing a superior facet complex (SFC) with soft tissue attachment points. The SFC receives one or more

inferior facet gliding arms (IFGAs) and associated joints which permit flexion, extension, lateral bending and/or other movements.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a drawing which shows the way in which the SFC and IFGA are positioned on a adjacent vertebra;

FIGURE 2 shows how a link may be provided for the lowest point SFC;

FIGURE 3 is a drawing that illustrates how a separate superior pedicle anchoring system may be used to accommodate the most proximal existing inferior/superior facet complex;

FIGURE 4 shows a system according to the invention in a neutral position;

FIGURE 5 shows the system and the way in which it facilitates extension;

FIGURE 6 shows the system and the way in which it facilities flexion;

FIGURE 7 shows the system and the way in which it facilities side-to-side or lateral bending;

FIGURE 8A is a drawing that shows how the IFGAs may use different flexible material;

FIGURE 8B shows the use of a curved slot;

FIGURE 8C illustrates multiple degrees of freedom;

FIGURE 9 shows the way in which two pivoting and/or gliding fixation points of the SFCs may extend down to the convex contour of the superior facet below;

FIGURE 10 depicts how a convex gliding surface preferably provides a slot for a pedicle post;

FIGURE 11 illustrates the accommodation of a gliding socket for a pedicle "ball;"

FIGURE 12 illustrates the use of anchoring pedicle screws which include a dynamic SFC blocking section, separate blocking nut, as well as a more stable proximal stem and separate IFGA ball;

FIGURE 13 shows how screws are preferably placed with the use of a symmetrical alignment guide to ensure that they are parallel and aligned in all planes;

FIGURE 14 shows a drill with a tab having depth markers applicable to the invention;

FIGURE 15 illustrates the way in which the pedicle screws are introduced into the vertebra using a symmetrical alignment guide;

FIGURE 16 shows how, once the SAG is properly positioned, a holding peg drill sleeve is placed into the opposing ends of the guide;

FIGURE 17 is drawing which illustrates the situation after the screws are introduced; and

FIGURE 18 shows the way the various pieces are assembled onto the anchoring pedicle screw, once in position.

DETAILED DESCRIPTION OF THE INVENTION

Figure 1 is a drawing which shows the way in which a superior facet complex (SFC) 102 and inferior facet gliding arms (IFGAs) 104, 106 are positioned on adjacent vertebrae 110, 112. At multiple levels, the IFGAs from an upper level may be attached through the upper points of a corresponding SFC. However, a link 202 may be provided for the lowest point SFC, as shown in Figure 2. A disk is shown at 212.

The SFC is generally fixed to the superior pedicles of the anatomic vertebrae-disc-vertebrae (VDV) complex, with appropriate contours relative to the joint surface to allow for gliding of the inferior facet. As shown in Figure 3, a separate superior pedicle anchoring design 302 may be used to accommodate the most proximal existing inferior/superior facet complex. The use of a central pedicle fixation anchor provides an attachment post for the inferior facet to interface with and use a gliding track and stop. Other arrangements may be accommodated, including ball and gliding socket designs, and the like.

Overall, the SFC according to the invention is preferably low in profile, and mimics the anatomy it replaces through the use of soft tissue attachment points. Figure 4 shows the system in a neutral position, whereas Figures 5, 6 and 7 respectively show how the components facilitate extension, flexion and side-to-side or lateral bending.

The IFGAs may use stiff or flexible material, attaching two pivoting and/or gliding fixation points of the SFCs, as shown in Figures 8 and 9, and extend down to the convex contour of the superior facet below. As shown in Figure 8A, an end of the IFGA arm 808 snaps onto a gliding peg 810 retained in the SFC 812. The IFGA may feature a curved slot 820, as shown in Figure 8B, facilitating at least the degrees of freedom depicted in Figure 8C. The use of a convex gliding surface preferably provides a slot for a pedicle post, as shown in Figure 10, retained with a locking cap 1002, or a gliding socket for a pedicle "ball" 1102 as shown in Figure 11. A convex gliding surface is shown at 1104, and tapered screw anchor at 1106 with locking mechanism 1108. Varying lengths may be provided according to the invention to mix and match so as to accommodate patient physiology, as appropriate.

The anchoring pedicle screws are low in profile, tapered and provide varying diameters and lengths, as appropriate. Different materials, including titanium, may be used for construction. As shown in Figure 12, the anchoring pedicle screws include a dynamic SFC locking section 1202, separate locking nut 1204, Morse taper proximal stem 1206 and a separate IFCG ball 1208. A screw holder 1210 fits onto the locking section for placement purposes, in conjunction with a holding peg drill sleeve 1212.

The screws are preferably placed with the use of a symmetrical alignment guide (SAG) 1330 and holder 1331, shown in Figure 13, to ensure that the anchor screws are parallel and aligned in all planes. A snap-on attachment 1332 may be provided, and the SAG may feature varying angles 1334 and serrated edges 1336. Other instruments include SAGs of varying widths and angles, holding pegs/drill reduction sleeves, drills with depth markings, tapered tabs with markings, feeler probes, screw holder, locking nut holder, and so forth. Figure 14, for example, shows a drill 1402 and tap 1404 with depth markers 1406, 1408 applicable to the invention.

Figure 15 illustrates the way in which the pedicle screws are introduced into the vertebrae 1502 using the symmetrical alignment guide 1330. Once the SAG is properly positioned, holding peg drill sleeves 1504, 1506 are placed into the opposing ends of the guide, and holes are drilled 1508 and tapped 1602, as shown in Figure 16, after which the

screws 1704 may be introduced as shown in Figure 17. Figure 18 shows the way the various pieces are assembled onto the anchoring pedicle screw 1800 once in position, including a toggle 1802 to accommodate different angles, SFC 1804, lock nut 1806, and ball 1808. The pedicle is shown at 1810.

In terms of an overall method, the posterior elements are removed, and the soft tissue is released or removed as necessary. Osteophytes are removed as well, as necessary. Any deformity correction not requiring pedicle fixation may be carried out at this stage.

Next the pedicle anchor screws are placed, as discussed above. Temporary distraction, compression is carried out through the pedicle screws as necessary to accommodate the next step. Intercanal work is now done, which may include stenosis, disc removal PLIF (posterior lumbar interbody fusion), artificial disc placement, and so forth. The SFCs are then placed. The most proximal specialized pedicle anchors and complex are placed, along with specialized most distal SFC.

The IFGAs are sized and placed proximal to distal, snapping into the SFC at midpoint of the gliding track, and onto the pedicle anchor (ball) at the midpoint of the inferior facet gliding track or socket.

The individual gilding arms/points are distracted/compressed/fixed or left dynamic, as appropriate. Dynamic function testing is then carried out, followed by soft tissue reattachment to the SFC enclosure.

The system described herein includes numerous advantages over existing approaches including at least the following:

1. Replaces the structural and functional aspects of the posterior elements of the thoracic and lumbar spine.

2. Allows complete removal of posterior elements for maximum access and decompression of neural tissues.

3. Allows maximum removal of arthritic bone and thickened tissues, to maximize correction of spinal deformity.